

Claims

1. An air impingement arrangement for compensating for the curling tendency of a paper or board web which is being treated, which air impingement arrangement (20; 20a, 20b) is disposed in connection with a paper or board process or with a related finishing process and extends substantially across the entire width of the web (10) running in the vicinity thereof and forms a contact-free web treatment zone, in which paper, board and/or finishing process the web is dried in at least one dryer unit (3, 5, 7) which comprises one or preferably several downwardly open single-wire draw groups, and in which paper, board and/or finishing process, optionally, in the dryer unit and/or after it, the web is subjected to an operation or operations which is/are selected from a group which includes reeling, calendering (4), intermediate calendering, coating (6), and additional drying (5, 7), **characterized** in that the air impingement produced in the web treatment zone by means of the air impingement arrangement (20; 20a, 20b) and directed at the web (10) includes, one following after the other, at least one hot blowing with air and at least one cold blowing with air.
2. An air impingement arrangement according to claim 1, **characterized** in that with the moisture which condenses and/or is absorbed into the web (10) in cold air blowing, the curl behaviour of the web changes to the range of structural, i.e. reversible curl behaviour.
3. An air impingement arrangement according to claim 1 and/or 2, **characterized** in that the air impingement in the air treatment zone of the web is applied to the free surface of the web (10).
4. An air impingement arrangement according to claim 1 and/or 2, **characterized** in that the air impingement in the air treatment zone of the web takes place through and/or by means of a drying wire (9) located on the web (10).

5. An air impingement arrangement according to claim 3 and/or 4, **characterized** in that the air impingement arrangement includes at least one hood (20, 20a, 20b) placed on top of a drying cylinder (23), a suction roll (28), an air impingement roll or a cooling cylinder.

5 6. An air impingement arrangement according to claim 5, **characterized** in that the air impingement arrangement is in connection with the last drying cylinder (23), suction roll (28), air impingement roll or cooling cylinder of the dryer unit (3, 5, 7), and that the air impingement arrangement comprises a hood (20) which is divided by a partition wall (27) into two sections, in which connection, in a machine direction, the web (10) is first
10 subjected to a blowing with hot air from a hot blowing part (21) of the hood (20) and after that to a blowing with cold air from a cold blowing part (22) of the hood.

7. An air impingement arrangement according to claim 6, **characterized** in that the air treatment zone of the web comprises a first and a second area which are defined by the
15 bipartite hood (20) at said hood and which extend across the width of the web (10).

8. An air impingement arrangement according to claim 5, **characterized** in that the air impingement arrangement comprises two successive and separate hoods (20a, 20b) placed
20 on top of two successive drying cylinders (23), suction rolls (28), air impingement rolls or cooling cylinders, the first of the hoods being a hot blowing part (21) blowing hot air and the latter of the hoods being a cold blowing part (22) blowing cold air.

9. An air impingement arrangement according to claim 8, **characterized** in that the air treatment zone of the web is bipartite and comprises separately a first area which extends
25 across the width of the web (10) and is located at the hot blowing part (21) placed first in a machine direction, and a second area which extends across the width of the web (10) and is located at the cold blowing part (22) placed after that in a machine direction.

10. An air impingement arrangement according to claim 8, **characterized** in that the hood
30 (20a) located first in a machine direction is in connection with the second last drying cylinder (23), suction roll (28), air impingement roll or cooling cylinder, and that the hood

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(20b) located after that in a machine direction is in connection with the last drying cylinder (23), suction roll (28), air impingement roll or cooling cylinder.

11. An air impingement arrangement according to claim 5, **characterized** in that the air impingement arrangement comprises a hood (20a) which is arranged in connection with a drying cylinder (23), suction roll, air impingement roll or cooling cylinder and which is a hot blowing part (21) blowing hot air against the web (10), and a blow box or an airborne drying unit (20b) which extends across the web and which is a cold blowing part (20b) blowing cold air against the web (10).

12. An air impingement arrangement according to claim 11, **characterized** in that the air treatment zone of the web is bipartite and comprises separately a first area which extends across the width of the web (10) and is located at the hood (20a) blowing hot air, and a second area which extends across the width of the web (10) and is located at the blow box or the airborne drying unit (20b) blowing cold air.

13. An air impingement arrangement according to claim 11, **characterized** in that the air impingement arrangement is in connection with the last drying cylinder (23), suction roll, air impingement roll or cooling cylinder of the dryer unit.

14. An air impingement arrangement according to any one of the preceding claims 1 to 13, **characterized** in that in order to cool the web further before it is processed further, a cooling cylinder (25) is additionally arranged to cool the web (10) in the air treatment zone or after it.

15. An air impingement arrangement according to any one of the preceding claims 1 to 14, **characterized** in that the temperature of air of the cold blowing part (22) is substantially lower than that of the hot blowing part (21), advantageously the temperature of air is below 50 °C in the cold blowing part (22).

16. A method for air impingement in order to compensate for the curling tendency of a paper or board web treated in connection with a paper or board process or with a related finishing process, in which air impingement method a contact-free web (10) treatment zone is formed, which treatment zone is extended to cover substantially the entire width of the web, in which paper, board and/or finishing process the web is dried in at least one dryer unit (3, 5, 7), which comprises one or preferably several downwardly open single-wire draw groups, and in which paper, board and/or finishing process, optionally, in the dryer unit and/or after it, the web is subjected to an operation or operations which is/are selected from a group which includes reeling, calendering (4), intermediate calendering, coating (6), and additional drying (5, 7), **characterized** in that, in at least one web (10) treatment zone, the web is subjected to impingement blowing with air, in which connection the web (10) is first subjected to at least one hot air blowing and after that to at least one cold air blowing.

17. An air impingement method according to claim 16, **characterized** in that moisture is condensed and/or absorbed into the web (10) by means of cold blowing, whereby the curl behaviour of the web is changed to the range of structural, i.e. reversible curl behaviour.

18. An air impingement method according to claim 16 and/or 17, **characterized** in that the air impingement in the web treatment zone is directed directly at the free surface of the web (9).

19. An air impingement method according to claim 16 and/or 17, **characterized** in that cold blowing is directed at the web from above the web (10) by means of and/or through a drying wire.

20. An air impingement method according to claim 18 and/or 19, **characterized** in that at least one hood (20, 20a, 20b) is used for air impingement, which hood is placed on top of a drying cylinder (23), a suction roll (28), an air impingement roll or a cooling cylinder and by means of which, in a machine direction, a blowing with hot air is first blown against the web (10) from a hot blowing part (21) and after that a blowing with cold air

from a cold blowing part (22), said drying cylinder (23), suction roll (28), air impingement roll or cooling cylinder being disposed in connection with the last drying cylinder (23), suction roll (28), air impingement roll or cooling cylinder of the dryer unit (3, 5, 7) and divided into two sections by means of a partition wall (27).

5 21. An air impingement method according to claim 18 and/or 19, **characterized** in that two separate hoods (20a, 20b) are used for air impingement, said hoods being placed on top of two successive drying cylinders (23), suction rolls (28), air impingement rolls or cooling cylinders disposed as the last cylinders/rolls in the dryer unit (3, 5, 7), hot air being blown through the hood (20a) which is placed first in a machine direction and which is a hot blowing part (21) blowing hot air and located in connection with the second last drying cylinder (23), suction roll (28), air impingement roll or cooling cylinder, and cold air being blown through the hood (20b) which is placed further down in a machine direction and which is a cold blowing part (22) blowing cold air and located in connection with the last drying cylinder (23), suction roll (28), air impingement roll or cooling cylinder.

20 22. An air impingement method according to claim 18 and/or 19, **characterized** in that for air impingement are used a hood (20a) arranged on top of and in connection with the last drying cylinder (23), suction roll, air impingement roll or cooling cylinder of the dryer unit (3, 5, 7), said hood being a hot blowing part (21) blowing hot air against the web (10), and a blow box or an airborne drying unit (20b) which extends across the width of the web and which is a cold blowing part (20b) blowing cold air against the web (10).

25 23. An air impingement method according to any one of the preceding claims 16 to 22, **characterized** in that the web (10) is further cooled during air impingement or after it by means of a cooling cylinder (25).

30 24. An air impingement method according to any one of the preceding claims 16 to 23, **characterized** in that the temperature of air is kept substantially lower in the cold blowing part (22) than in the hot blowing part (21), advantageously below 50 °C.

25. A paper or board machine which includes at least a former unit (1) for a paper or board web, a press unit (2) and at least one dryer unit (3, 5, 7), in which paper or board machine, for the purpose of compensating for the curl of the web, the web (10) is subjected to at least one air impingement which, arranged in connection with a paper or board process or with a related finishing process, extends substantially across the entire width of the web (10) running in the vicinity of the air impingement and forms a contact-free web treatment zone with the web, **characterized** in that the air impingement applied to the web (10) includes, following one after the other, at least one hot blowing and at least one cold blowing with air.

26. A paper or board machine according to claim 25, **characterized** in that with the moisture which condenses and/or is absorbed into the web (10) in cold blowing, the curl behaviour of the web changes to the range of structural, i.e. reversible curl behaviour.

27. A paper or board machine according to claim 25 and/or 26, **characterized** in that the air impingement in the air treatment zone of the web is applied to the free surface of the web (10).

28. A paper or board machine according to claim 25 and/or 26, **characterized** in that the air impingement in the air treatment zone of the web is applied to a drying web (9) located on the web (10) and through and/or by means of it to the web (10).

29. A paper or board machine according to claim 27 and/or 28, **characterized** in that each air impingement arrangement includes at least one hood (20, 20a, 20b) which is placed on top of the last drying cylinder (23), suction roll, air impingement roll or cooling cylinder of the dryer unit (3, 5, 7) and divided by a partition wall (27), in which connection, in a machine direction, the web (10) is first subjected to a blowing with hot air from a hot blowing part (21) of the hood and after that to a blowing with cold air from a cold blowing part (22) of the hood.

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30. A paper or board machine according to claim 27 and/or 28, **characterized** in that the air impingement arrangement comprises two successive and separate hoods (20a, 20b) placed on top of the last drying cylinders (23), suction rolls, air impingement rolls and/or cooling cylinders of the dryer unit (3, 5, 7), in which connection, in a machine direction, the web (10) is first subjected to a blowing with hot air from the first hood (20a) serving as a hot blowing part (21) and after that to a blowing with cold air from the second hood (20b) serving as a cold blowing part (22).

31. A paper or board machine according to claim 27 and/or 28, **characterized** in that the air impingement arrangement comprises a hood (20a) which is placed first in a machine direction on top of the last drying cylinder (23), suction roll, air impingement roll or cooling cylinder of the dryer unit (3, 5, 7) and which serves as a hot blowing part (21) and blows hot air against the web (10); and a blow box or an airborne drying unit (20b) which extends across the entire width of the web and which serves as a cold blowing part (22) and blows cold air against the web (10).

32. A paper or board machine according to any one of the preceding claims 25 to 31, **characterized** by a cooling cylinder (25) which acts on the web (10) in a machine direction during or after air impingement.

33. A paper or board machine according to any one of the preceding claims 25 to 32, **characterized** in that the temperature of air of the cold blowing part (22) is substantially lower than that of the hot blowing part (21), advantageously the air temperature in the cold blowing part (22) is below 50 °C.

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